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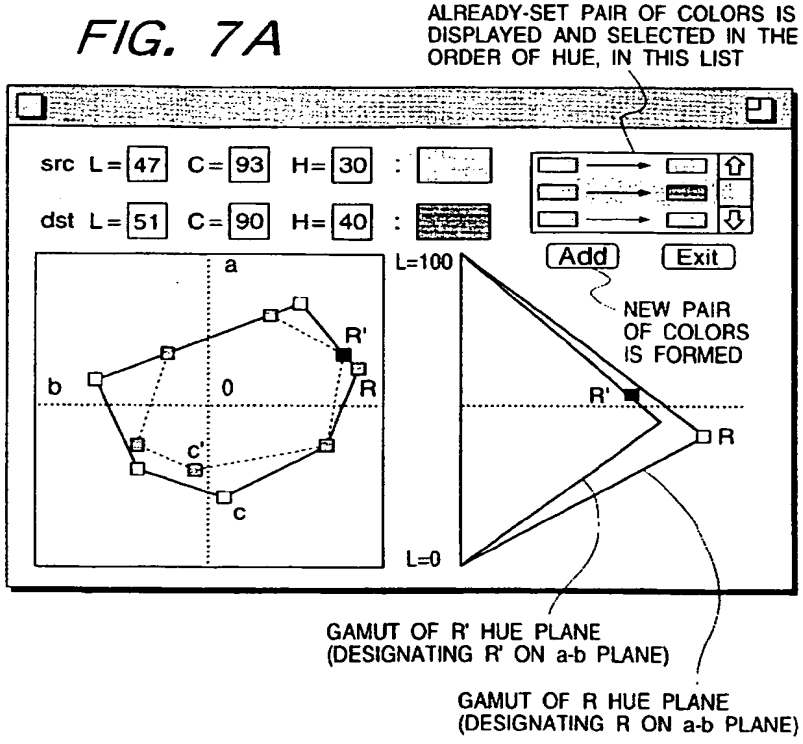
(54) Selective colour correction method

(57) The present invention intends to simply provide an image which can obtain a desired impression by adjusting a color on the basis of a color adjustment parameter which responds to input image data. The image processing apparatus comprises storage means for storing image data which has different hue, input means for inputting image data objected to be color adjusted, and color adjustment means for performing a color adjustment to at least one of hue, saturation and lightness of the image data objected to be color adjusted using a color adjustment parameter which responds to each of the hue, the saturation and the lightness of the image data objected to be color adjusted on the basis of the stored image data which is selected on the basis of the hue of the image data objected to be color adjusted.

FIG. 7A



EP 0 720 352 A1

Description

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to an image processing apparatus and method for performing a color adjustment.

Related Background Art

Hitherto, as a color adjustment method, there has been known such a method as adjusting all colors contained in an image on the basis of a parameter used for converting a specific input color in an image into a specific output color.

That is, concretely, a color adjustment is performed by converting input image data by using a matrix parameter used for converting the input image data which indicates such a specific color as a skin color or the like into image data which indicates a desired skin color.

In a conventional color adjustment method, a desired color adjustment can be performed for the specific input color. However, such a color adjustment as disregarding the color appearance is compelled to be performed for other colors, because the color adjustment is performed by using the same parameter for an entire image. Therefore, there occurs such a problem as an impression of an image formed by after-adjustment colors differs from an impression of an image formed by before-adjustment colors.

SUMMARY OF THE INVENTION

The present invention is applied in consideration of the above-mentioned problem, and a concern of the present invention is to simply provide an image in which a desired impression can be obtained by adjusting colors on the basis of a color adjustment parameter corresponding to input image data.

Another concern of the present invention is to realize such state as a color adjustment does not influence to an achromatic color when the color adjustment is performed.

The above and other features of the present invention will become apparent from the following detail description on the basis of the attached drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a block diagram showing an example of an image processing apparatus according to a first embodiment of the present invention;

Fig. 2 is a flow chart showing an example of an entire process flow in the first embodiment of the present invention;

Fig. 3 is a flow chart showing an example of a color adjustment process flow in the first embodiment of the present invention;

Fig. 4 is a view showing an example which indicates factors of the hue set (group) as dots on a circumference of which center is positioned on an origin of an a^*-b^* plane called as a hue circle;

Fig. 5 is a block diagram of a central processing device 15;

Fig. 6 is a block diagram of a color revision unit 52; and

Figs. 7A and 7B are views showing plural before and after-adjustment values to be stored in a memory device.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

An embodiment of the present invention will be described hereinafter. In the embodiment, it should be noted that the same reference numeral denotes the same object through all drawings.

(First Embodiment)

A first embodiment of the present invention will be described in detail hereinafter with reference to the attached drawings.

Fig. 1 is a block diagram showing an example of an image processing apparatus according to the present invention.

A display device 11 is composed of a CRT, a liquid crystal display or the like. A position indication device 12 is composed of a mouse, a light pen or the like which indicates a position of information displayed on the display device 11. An input device 13, for example, a key board or the like, inputs information such as characters, numerals and the like. A memory device 14 stores a program for entirely controlling a color adjustment device, generated data or the

like. A central processing device 15 entirely controls the color adjustment device. The device 15 performs such controls as displaying information on the display device 11, confirming information indicated by the position indication device 12 and the input device 13, reading out necessary data from the memory device 14, or the like.

An image input device 16 is composed of a scanner, a video camera or the like. An image output device 17 is composed of a printer or the like. A storing medium read device 18 reads such information as a program, data or the like from a storing medium such as a floppy disk in which a program for controlling a part or an entire of an image edition method is stored. The read information is stored in the memory device 14.

It should be noted that the image input device 16, the image output device 17 and the storing medium read device 18 may be provided if such devices are required.

In the present embodiment, hue components, saturation components and lightness components of all colors depend on the following equation based on a CIE1976 ($L^*a^*b^*$) color-space. In this case, the hue component is expressed by using an angle. In the present embodiment, it is expressed by using an angle in radian.

$$\begin{cases} L^* : \text{lightness} \\ C^*_{ab} = (a^{*2}+b^{*2})^{\frac{1}{2}} : \text{saturation} \\ h^{\circ}_{ab} = \arctan\left(\dfrac{b^*}{a^*}\right) : \text{hue} \end{cases}$$

A hue value having the same phase each other, for example, the hue value π and the hue value 3π are the same hue, therefore, hue sets (hue groups) are arranged in a circulated permutation if they are arranged based on a size relation.

The hue value is limited within a range of $(-\pi, \pi)$ hereinafter, and a mono-directional hue difference is defined as follows.

$$d_H(h_1, h_2) = \begin{cases} h_1 - h_2 & ((h_1 - h_2) \geq 0), \\ (h_1 - h_2) + 2\pi & ((h_1 - h_2) < 0) \end{cases}$$

In a hue set $\{h_i : 1 \leq i \leq N\}$, a factor h_R which is "closest in clockwise direction" to a certain hue h is equal to h_j which is obtained when Δh_j becomes minimized in a set $\{\Delta h_i : 1 \leq i \leq N\}$ if $\Delta h_i = d_H(h, h_i)$. In the hue set $\{h_i : 1 \leq i \leq N\}$, a factor h_L which is "closest in counterclockwise direction" to a certain hue h is equal to h_j which is obtained when Δh_j becomes minimized in the set $\{\Delta h_i : 1 \leq i \leq N\}$ if $\Delta h_i = d_H(h_i, h)$.

Fig. 4 is a view showing an example which indicates factors 32, 33, 34, 35, 36, 37 and 38 as dots on a circumference 39 (called as a hue circle) of which center is positioned on an origin of an a^*-b^* plane, because if the hue is expressed by using an angle, the hue sets are arranged in the circulated permutation. In Fig. 4, a hue which is closest to the hue h indicated by the dot 31 in clockwise direction is the hue h_R indicated by the dot 32, and a hue which is closest to the hue h indicated by the dot 31 in counterclockwise direction is a hue h_L indicated by the dot 33.

Fig. 2 is a flow chart showing an operation flow of a color adjustment method according to the present invention. It should be noted that an operation described in the flow chart in Fig. 2 is performed by the central processing unit 15 on the basis of a control program stored in the memory device 14.

At first, the number of color is set as 1, that is, an initialization is performed (step 21).

Then, a user inputs a before-adjustment color to be designated by using the input device 13 (step 22) and inputs an after-adjustment color which corresponds to it (before-adjustment color) by using the input device 13 (step 23). Then, it is judged that if a pair of before and after-adjustment colors has already been input (step 24). If it has not been terminated to input the pair of before- and after-adjustment colors, the number of pairs of colors should be increased by one (step 25) and then the flow returns to the step 22. If it has been terminated to input the pair of before-and after-adjustment colors, the flow advances to a step 26.

However, in the steps 22 to 25, when before- and after-adjustment colors are repeatedly input, before-adjustment colors are set to be different from others.

The pair of before- and after-adjustment colors which has been input is stored in the memory device 104. The stored pair of before- and after-adjustment colors may be deleted or may be stored after terminating a color adjustment process.

Here, the total number of pairs of before- and after-adjustment colors is defined as N.

Then, the user performs the color adjustment process. The user inputs a color x to which a color adjustment is performed by using the input device 13 (step 26). The hue component, the saturation component and the lightness

component of the color x are assumed as h, c and l, respectively.

A color x_R of which hue is closest to the hue component h of the color x in clockwise direction is searched from the before-adjustment colors which have been input in the steps 22 to 25. The hue component, the saturation component and the lightness component of the color x_R are assumed as h_R, c_R and l_R, respectively.

Further, a color after performing an adjustment of the color x_R which is input in the step 23 is assumed as x'_R. The hue component, the saturation component and the lightness component of the color x'_R are assumed as h'_R, c'_R and l'_R, respectively (step 27).

A color x_L of which hue is closest to the hue component h of the color x in counterclockwise direction is searched from the before-adjustment colors which have been input in the steps 22 to 25. The hue component, the saturation component and the lightness component of color x_L are assumed as h_L, c_L and l_L, respectively.

Further, a color after performing an adjustment of the color x_L which is input in the step 23 is assumed as x'_L. The hue component, the saturation component and the lightness component of the color x'_L are assumed as h'_L, c'_L and l'_L, respectively (step 28).

At this time, it is assumed that $\Delta h_{LR} = d_H(h_L, h_R)$, $\Delta h'_{LR} = d_H(h'_L, h'_R)$, $\Delta h_R = d_H(h, h_R)$ and $\Delta h_L = d_H(h_L, h)$.

In this process, the color adjustment is performed, wherein the hue component, the saturation component and the lightness component of colors to be color adjusted are calculated. (step 29).

The color adjustment method will be described in detail with reference to Fig. 3.

The lightness component l' of a color x' obtained after performing the color adjustment of the color x is defined as follows (step 2C).

$$\begin{cases} l' = \left(1 + (l'_R - l_R) \times \dfrac{C}{C_R}\right) \times \dfrac{\Delta h_L}{\Delta h_{LR}} + \left(1 + (l'_L - l_L) \times \dfrac{C}{C_L}\right) \times \dfrac{\Delta h_R}{\Delta h_{LR}} & (N \neq 1), \\ l' = l + (l'_R - l_R) \times \dfrac{C}{C_R} & (N = 1) \end{cases}$$

The saturation component c' of the color x' obtained after performing the color adjustment of the color x is defined as follows (step 2D).

$$\begin{cases} C' = \left(C'_R \times \dfrac{C}{C_R}\right) \times \dfrac{\Delta h_L}{\Delta h_{LR}} + \left(C'_L \times \dfrac{C}{C_L}\right) \times \dfrac{\Delta h_R}{\Delta h_{LR}} & (N \neq 1), \\ C' = C'_R \times \dfrac{C}{C_R} & (N = 1) \end{cases}$$

The hue component h' of the color x' obtained after performing the color adjustment of the color x is defined as follows (step 2E).

$$\begin{cases} h' = h'_R + \Delta h'_{LR} \times \dfrac{\Delta h_R}{\Delta h_{LR}} & (N \neq 1), \\ h' = h + (h'_R - h_R) & (N = 1) \end{cases}$$

As mentioned above, the color adjustment method indicated in Fig. 3 mainly related to a hue adjustment.

That is, an adjustment is performed by using a hue adjustment parameter which is only based on the hue of colors x, x_R, x'_R, x_L and x'_L in accordance with a hue adjustment method indicated in the step 2E.

Therefore, since the hue is not influenced by other factors of the lightness and the saturation, the hue can be adjusted to a desired hue.

A saturation adjustment indicated in the step 2D is performed based on a saturation adjustment parameter obtained by performing a weighting in accordance with the hue of the color x.

That is, in colors x_R and x_L selected based on the hue, an influence becomes more remarkable by a color which is close to the color x.

Therefore, the saturation adjustment is performed under consideration of the hue adjustment.

A lightness adjustment indicated in the step 2E is performed by using a lightness adjustment parameter which is based on the saturation and the hue.

That is, since calculated results of C/C_R and C/C_L are regarded as parameters, an adjustment range in the lightness becomes narrower when the saturation becomes more weak i.e., a dot representing the saturation is closer to an achromatic axis.

Accordingly, an achromatic color can be accurately reproduced if the color adjustment is performed.

As mentioned above, according to the color adjustment of the present embodiment, since the hue, the saturation and the lightness are adjusted on the basis of the same colors x_R and x_L, the color adjustment can be performed by associating the hue, the saturation and the lightness with the hue which is regarded as a main factor.

The above-defined color x' after performing the color adjustment is output on the display device 11 (step 2A).

Then, it is judged that if a color to be adjusted has already been input (step 2B). If it has not been terminated to input the color to be adjusted, the flow returns to the step 26. If it has been terminated to input the color to be adjusted, the present color adjustment method is terminated.

According to the present embodiment, if the user inputs only pairs of colors to be adjusted and already-adjusted colors. The before-adjustment colors designated by performing the input in the step 22 are all converted into the corresponding after-adjustment colors designated by performing the input in the step 23. As to other colors, the color adjustment, wherein the conversion is performed according to the pairs of designated before- and after-adjustment colors, can be performed.

That is, the color which is designated is converted into the desired color on the basis of the pair of designated before- and after-adjustment colors. Further, the color which is not designated is converted into the parameter corresponding to the color which is not designated on the basis of the pair of designated before- and after-adjustment colors.

The adjustment is performed by using the parameters corresponding to the respective input colors in order to perform the desired color adjustment to the image.

Therefore, a suitable color adjustment can be performed to colors other than designated colors. As a result, an image having a desired impression can be simply obtained without a complex operation.

Since the before-adjustment colors designated by performing the input operation in the step 22 are all converted into the corresponding after-adjustment colors designated by performing the input operation in the step 23, colors to be intended to output correct colors of a merchandise and its logo can be accurately designated and adjusted.

Simultaneously, since the color which is not designated in the step 22 is varied in response to a color of which hue is closest to the hue of the designated color in clockwise direction, a color of which hue is closest to the hue of the designated color in counterclockwise direction and their respective mono-directional hue differences. Thus, an entire color after adjustment is not polarized, and an achromatic color before adjustment is not varied at all. That is, since it is not varied to a chromatic color, the color adjustment can be performed without generating any color polarization which gives an unnatural impression to the user.

(Second Embodiment)

Fig. 5 is a block diagram of the central processing device 15 for realizing the color adjustment process described in the first embodiment. A plurality of before- and after-adjustment values shown in Fig. 5 are input from an input device 13 or a position indication device 12 through a data input unit 55 on the basis of such displays as shown in Figs. 7A and 7B, to store the values in a memory device 14.

In an image processing unit 50, a desired image processing is executed to image data indicating an objected image which is input from an image input device 16 to output it to an output device (a display device 11 and an image output device 17).

A data input unit 55 and the image processing unit 50 are connected to a central processing unit (CPU) 57, a random access memory (RAM) 58 and the memory device 14 through a bus 56.

The CPU 57 produces a color correction parameter, sets the parameter which is supplied to a color revision unit 52 and controls each processing unit on the basis of a program stored in the memory device 14 and the plural before- and after-adjustment values.

In the image processing unit 50, the color adjustment described in the first embodiment and a color correction process for correcting data to image data which is adapted to the characteristic of an output device are executed to the image data indicating the target image.

In the color revision unit 52, a desired color adjustment according to a predetermined pixel is performed to image data indicating the predetermined pixel which is input through an image data input unit 51, on the basis of the color correction parameter which is set by the CPU 57.

A color correction unit 53 performs a color correction to the color-adjusted image data on the basis of the characteristic of the output device (the display device 11 or the image output device 17). A color appearance of the image data which is color adjusted on the above color correction can be faithfully reproduced on an output image.

It should be noted that the CPU 57 sets a parameter adapted to the output device which forms an image, since each output device has the different characteristic. An image formation method of the display device differs from that of the image output device. The display device 11 displays an image on the basis of R, G and B image data. On the other hand, the image output device forms an image on a recording medium utilizing a recording material corresponding to each of Y, M, C and K colors, on the basis of Y, M, C and K image data. Therefore, the color correction unit 53 converts data into data of a color system which is adapted to the output device.

An output unit 54 outputs the color corrected image data to a desired output device.

Fig. 6 is a view showing the structure of the color revision unit 52. In a color-space conversion unit 1 (61), the R_1, G_1 and B_1 image data indicating the target image is converted into L*, a* and b* image data on an L* a* b* color system. A color adjustment unit 62 performs the color adjustment shown in Fig. 3. The CPU 57 generates the color correction parameter used in the color adjustment on the basis of the plural before- and after-adjustment values stored in the memory device 14 (refer to steps 21 to 29 in Fig. 2).

Color-adjusted L*, a* and b* image data are respectively converted into R_2, G_2 and B_2 image data which is represented on a predetermined RGB color system by a color-space conversion unit 2 (63). As the predetermined RGB color system, for example, an NTSC-RGB color system will be given.

Figs. 7A and 7B show an example of a display screen when the plural before- and after-adjustment values to be stored in the memory device are set (refer to steps 22 to 25 in Fig. 2).

As shown in Fig. 7A, such views as displaying values of L, h and c components of before- and after-adjustment values, displaying colors thereof, displaying a list of set pairs of before- and after-adjustment values, plotting such pairs on an a*-b* plane and indicating a gamut relation between before-adjustment values in a predetermined hue and the output device are shown. Fig. 7B shows the a*-b* plane when a pair of before- and after-adjustment colors is added. Here, a reference numeral A denotes a before-adjustment color and a reference numeral A' denotes an after-adjustment color.

(Another embodiment)

In the first embodiment of the present invention, the lightness component, the saturation component and the hue component of the after-adjustment color have been calculated in the step 29. However, in the present embodiment, only a lightness component, a saturation component, a hue component, the lightness and the saturation components, the lightness and the hue components or the saturation and the hue components may be calculated.

That is, a user may preferably select components to be color adjusted by instructing the components to be color adjusted from a console unit (not shown).

For the components which are not selected, a color adjustment is not to be performed, for example, by setting an adjustment parameter which omits a conversion process or providing such a constitution as a color adjustment process is passed through.

In the first embodiment of the present invention, the pair of before- and after-adjustment colors has been input in the steps 22 and 23 by using the input device 13. However, in the present embodiment, the user may input a pair of before- and after-adjustment colors by instructing colors of an image or the like displayed on a display device 11 using a position indication device 12 or utilizing the pair of before- and after-adjustment colors which has been previously stored in a memory device 14.

In the first embodiment of the present invention, a color to be color adjusted has been input using the input device 13 in the step 26 to output a color which has been color adjusted on the display device 11 in the step 2A. However, the present invention is not limited to the above-mentioned example, but may be performed the color adjustment process to image data utilizing a palette in a form of palette, wherein a color which is input in a step 26 is responded to a color after performing a color adjustment obtained in the step 2A.

The process from the step 26 to the step 2A may be executed every time for each of input data indicating an objected image without using the palette.

The process may be executed to a part of an objected image.

In a step 2D of the present embodiment, a saturation component c' of a color x' after performing the color adjustment to a color x may be calculated as follows.

$$\begin{cases} C' = (C^{\log c'_R / \log c_R}) \times \dfrac{\Delta h_L}{\Delta h_{LR}} + (C^{\log c'_L / \log c_L}) \times \dfrac{\Delta h_R}{\Delta h_{LR}} & (N \neq 1), \\ C' = C^{\log c'_R / \log c_R} & (N = 1) \end{cases}$$

In the present embodiment, the hue component, the saturation component and the lightness component of a color depend on a CIE1976 (L* a* b*) color space. However, the hue component, the saturation component and the lightness component which depend on a CIE1976 (L* u* v*) color space, an HSV color representation system depending on a display characteristic or an HLS color representation system may be used.

That is, a color space which is expressed by the hue component, the saturation component and the lightness component may be acceptable.

As described above, according to the present invention, an image which can obtain a desired impression can be simply provided by performing the color adjustment on the basis of a color adjustment parameter which responds to input image data.

Also, the color adjustment process does not influence to an achromatic color when colors are adjusted.

Claims

1. An image processing apparatus comprising:

   storage means for storing image data which has different hue and indicates plural before- and after-adjustment colors;
   input means for inputting image data designated to be color adjusted; and
   color adjustment means for performing a color adjustment to at least one of hue, saturation and lightness of the image data designated to be color adjusted using a color adjustment parameter which corresponds to each of the hue, the saturation and the lightness of the image data designated to be color adjusted and on the basis of the stored image data which is selected on the basis of the hue of the image data designated to be color adjusted.

2. An apparatus according to claim 1, wherein the color adjustment concerning the hue in said color adjustment means is performed on the basis of the image data designated to be color adjusted and the hue of the selected image data.

3. An apparatus according to claim 1, wherein the color adjustment concerning the saturation in said color adjustment means is performed on the basis of the image data designated to be color adjusted and the hue and the saturation of the selected image data.

4. An apparatus according to claim 1, wherein the color adjustment concerning the lightness in said color adjustment means is performed on the basis of the image data designated to be color adjusted and the hue, the saturation and the lightness of the selected image data.

5. An apparatus according to claim 1, wherein the color adjustment in said color adjustment means for the hue, the saturation and the lightness is respectively different, but the color adjustment is all performed on the basis of the hue.

6. An apparatus according to claim 1, further comprising instruction means for instructing what component is color adjusted from the hue, the saturation and the lightness, and wherein said color adjustment means performs the color adjustment to the instructed component.

7. An image processing apparatus comprising:

   input means for inputting image data;
   detection means for detecting hue of the image data;
   setting means for setting a lightness adjustment parameter concerning lightness of the image data on the

basis of achromatisity in the detected hue; and
color adjustment means for performing a color adjustment to the image data on the basis of the lightness adjustment parameter.

8. An apparatus according to claim 7, further comprising storage means for storing plural representative image data; and selection means for selecting image data from said storage means on the basis of the hue of the input image data, and wherein achromatisity in the hue is extracted on the basis of saturation of the selected image data and the saturation of the input image data.

9. An image processing method comprising the steps of:

storing image data having different hue; and
inputting image data subjected to be color adjusted,
wherein a color adjustment is performed using a color adjustment parameter which corresponds to each of hue, saturation and lightness of the image data objected to be color adjusted in response to the stored image data which is selected on the basis of the hue of the image data objected to be color adjusted.

10. An image processing method comprising the steps of:

inputting image data;
detecting hue, saturation and lightness of the image data; and
setting a lightness adjustment parameter concerning the lightness on the basis of the detected hue and the saturation,
wherein the image data is color adjusted on the basis of the lightness adjustment parameter.

11. An image processing method comprising the steps of:

inputting image data; and
calculating achromatisity in hue of the image data,
wherein lightness of the image data is adjusted on the basis of the achromatisity.

FIG. 1

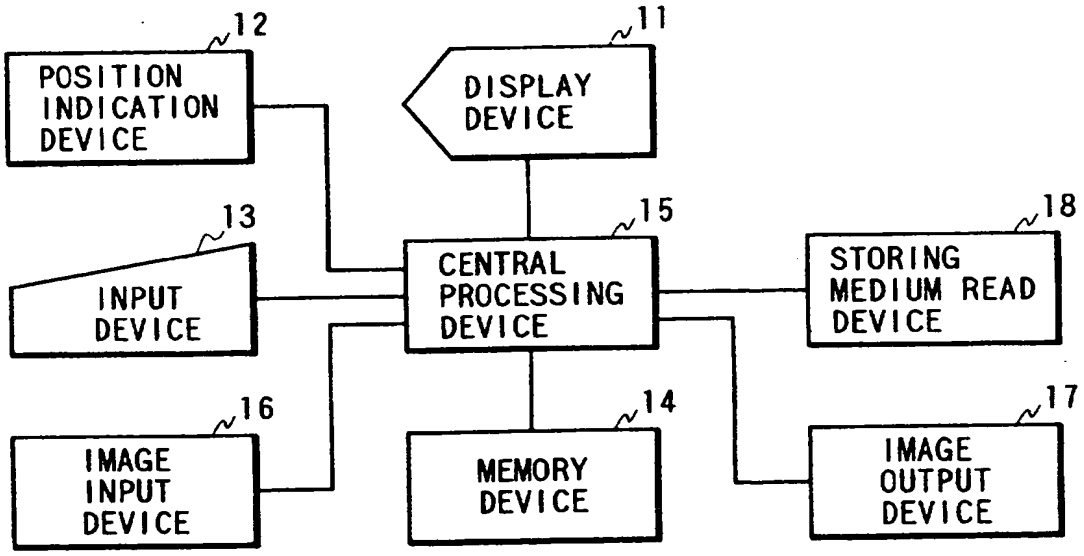


FIG. 2

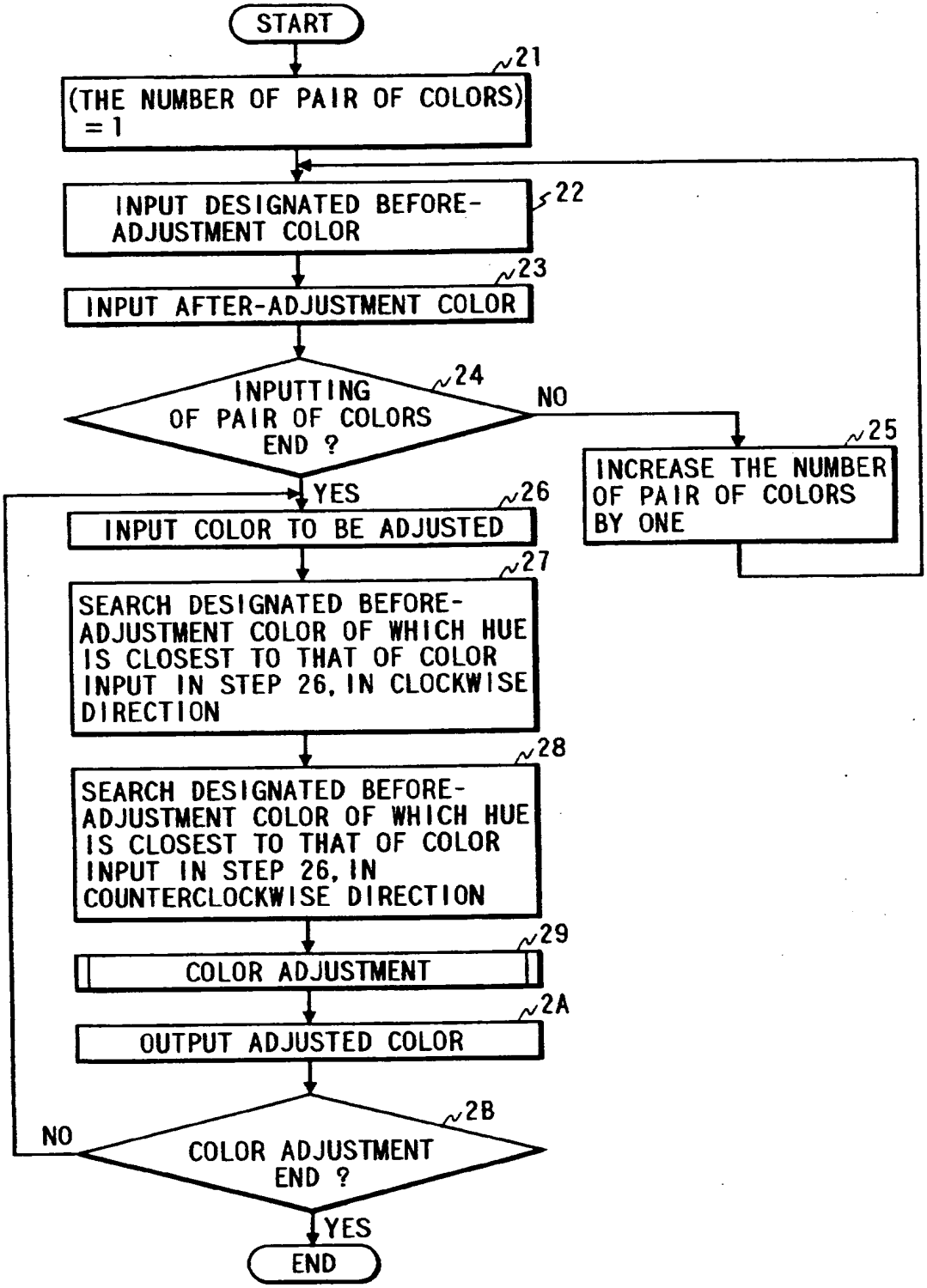


FIG. 3

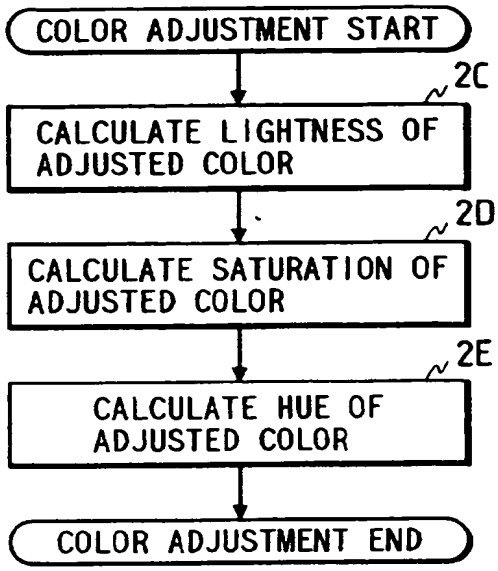
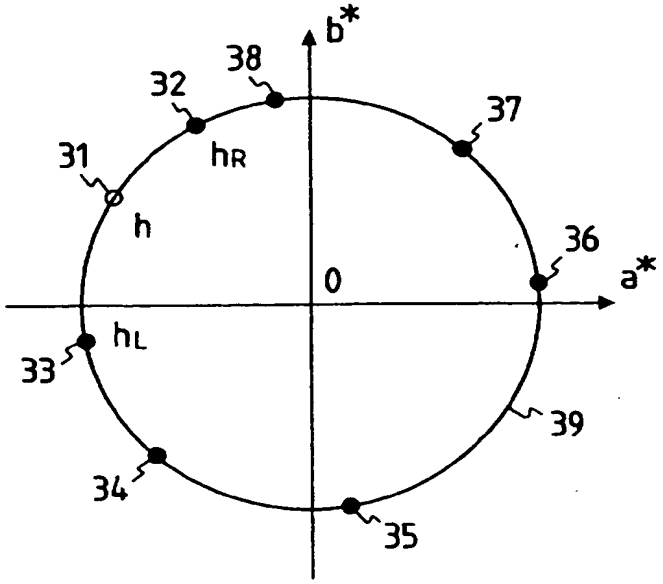


FIG. 4



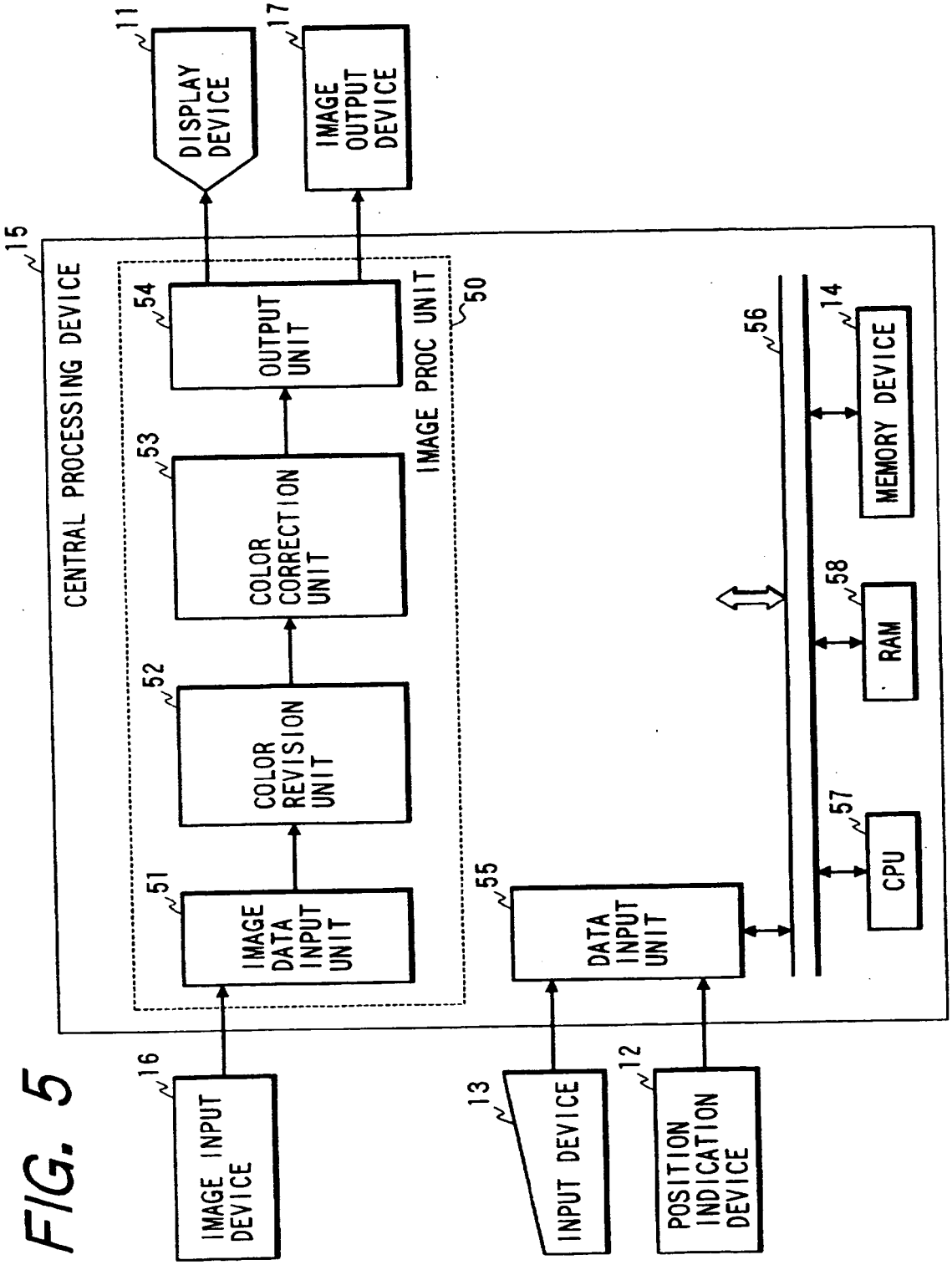


FIG. 5

FIG. 6

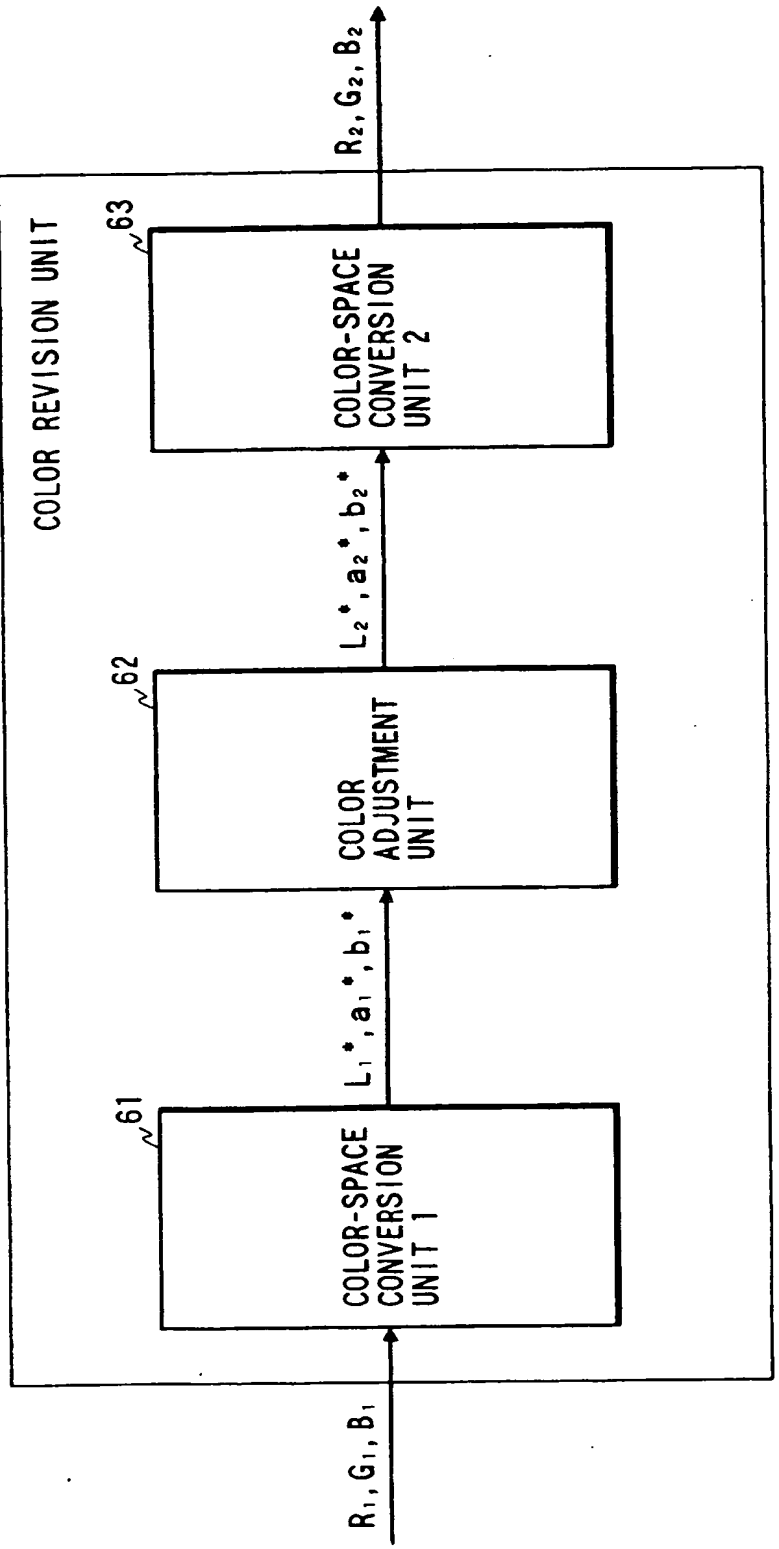


FIG. 7A

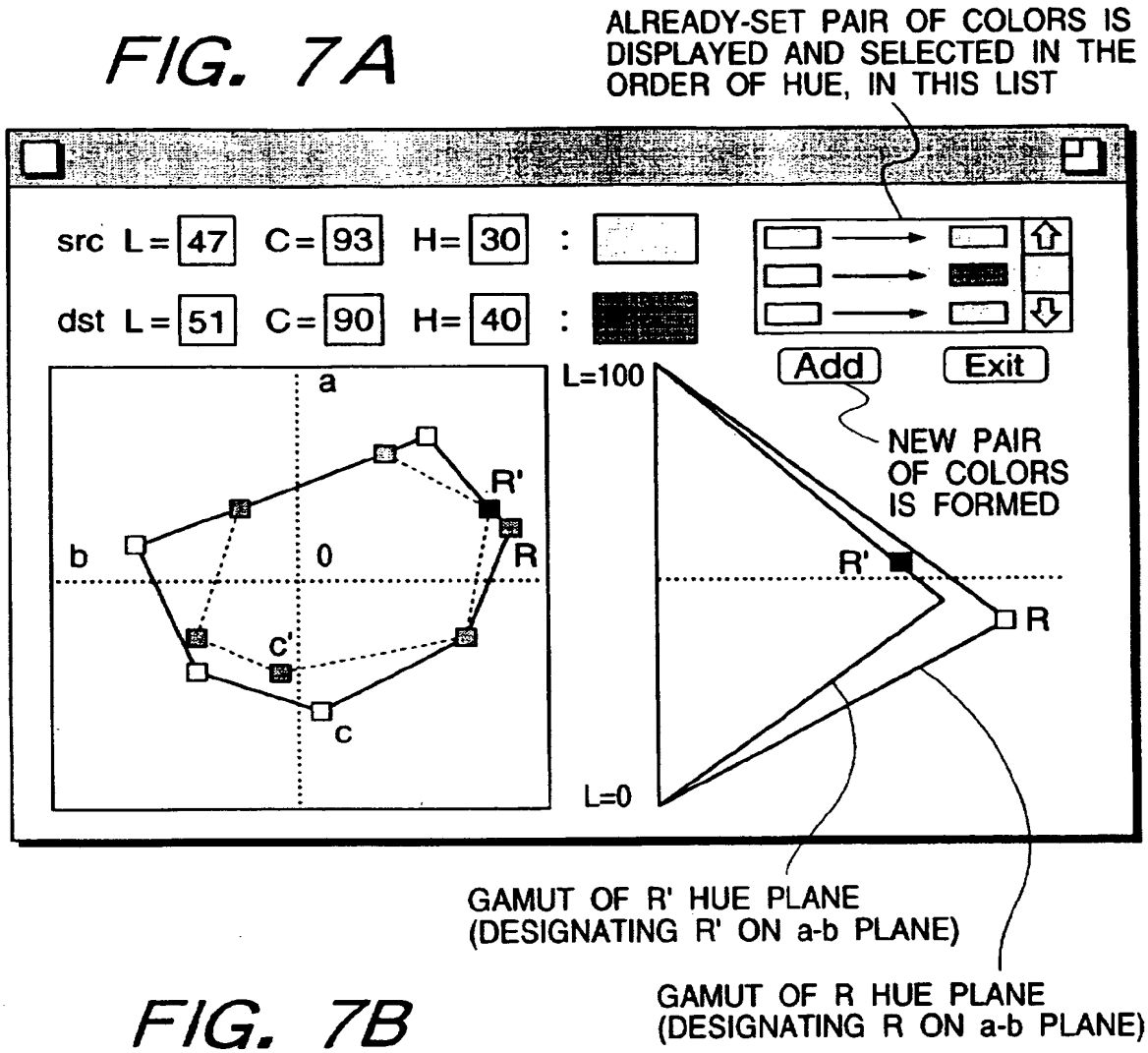
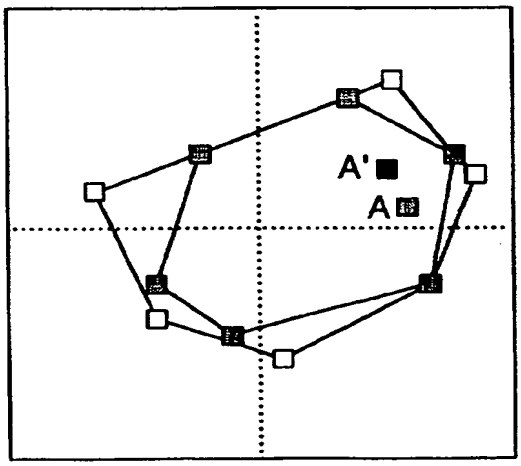


FIG. 7B



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EUROPEAN SEARCH REPORT

Application Number
EP 95 30 9440

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
Y	'LinoColor 3.1, Neue Funktionen' March 1993 , LINOTYPE-HELL AG , ESCHBORN, GERMANY * page 6.1 - page 9.25 *	1-11	H04N1/62 H04N1/60
Y	GB-A-2 208 460 (NEC HOME ELECTRONICS LTD) * abstract; figures 1-3 * * page 4, line 4 - page 11, line 4 *	1-11	
A	EP-A-0 546 773 (XEROX) * abstract; figures 1-10 * * page 5, line 24 - line 41 * * page 6, line 23 - line 42 * * column 7, line 20 - line 28 * * page 11, line 5 - page 12, line 5 *	1-11	
A	EP-A-0 536 892 (XEROX) * abstract; figures 1-8 * * column 10, line 41 - column 12, line 50 * * column 13, line 57 - column 15, line 22 *	1-11	TECHNICAL FIELDS SEARCHED (Int.Cl.6) H04N
A	EP-A-0 481 525 (MATSUSHITA ELECTRIC) * abstract; figures 1-15 * * column 15, line 8 - column 17, line 4 * * column 21, line 10 - column 22, line 23 *	1-11	
A	DE-A-43 43 362 (LINOTYPE-HELL AG) * abstract; figures 1-12 * * page 5, line 11 - page 6, line 1 * * page 9, line 16 - line 27 *		

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	4 April 1996	Kassow, H

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

FIG. 1

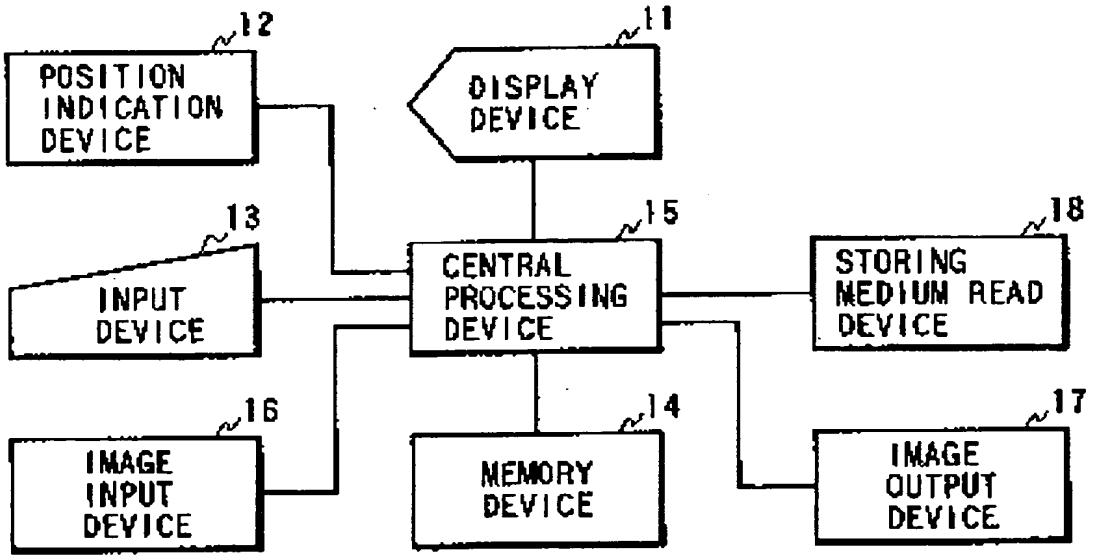
12
POSITION INDICATION DEVICE
11
DISPLAY DEVICE
13
INPUT DEVICE
15
CENTRAL PROCESSING DEVICE
18
STORING MEDIUM READ DEVICE
16
IMAGE INPUT DEVICE
14
MEMORY DEVICE
17
IMAGE OUTPUT DEVICE

FIG. 2

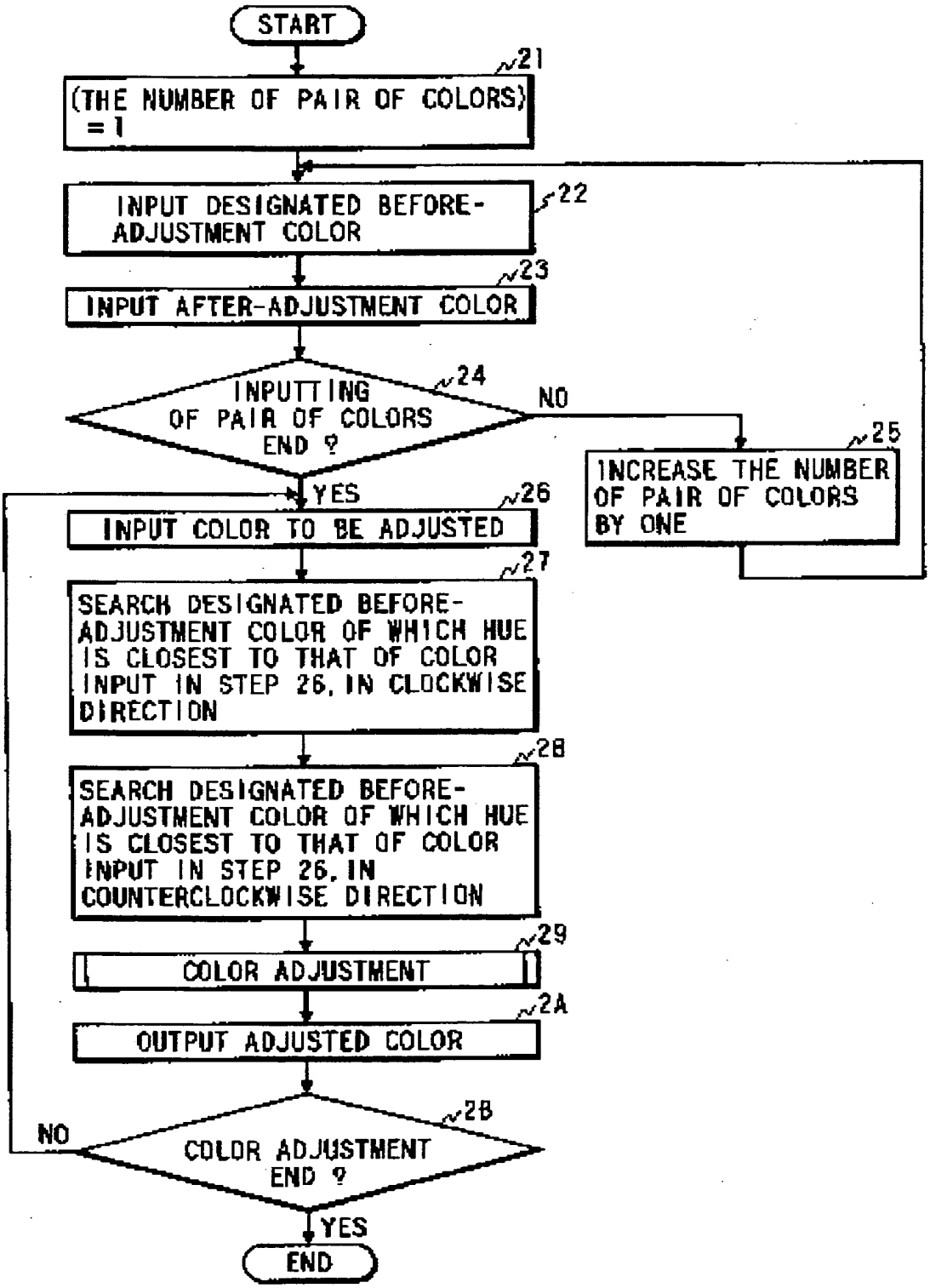

FIG. 3

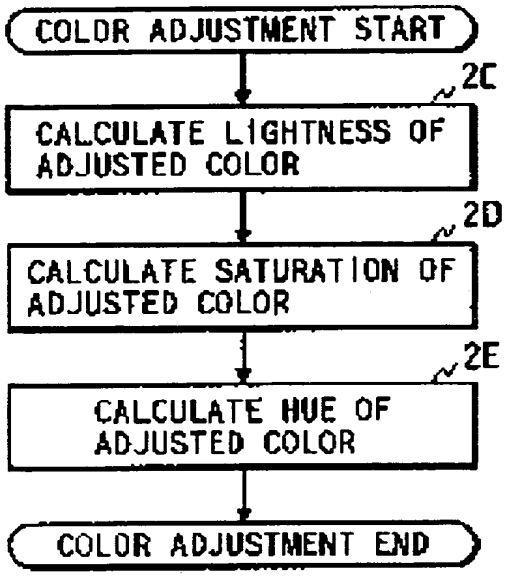
COLOR ADJUSTMENT START
2C
CALCULATE LIGHTNESS OF ADJUSTED COLOR
2D
CALCULATE SATURATION OF ADJUSTED COLOR
2E
CALCULATE HUE OF ADJUSTED COLOR
COLOR ADJUSTMENT END

FIG. 4

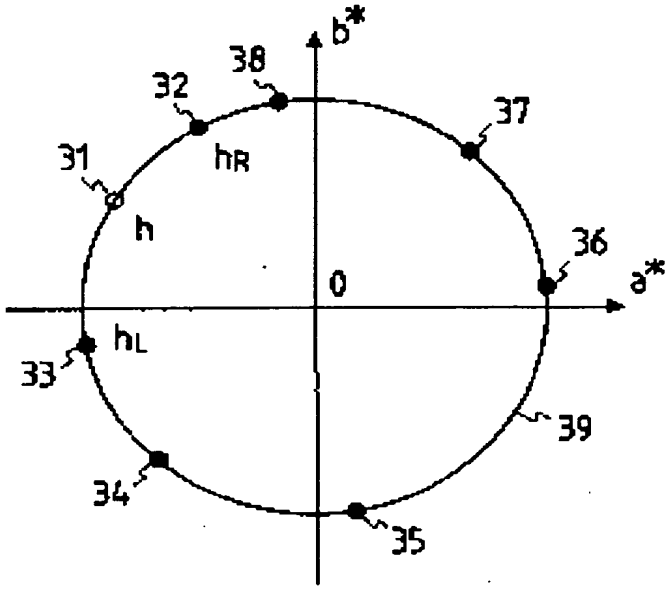
b*
38
32
37
31
hR
h
36
0
a*
hL
33
39
34
35

FIG. 5

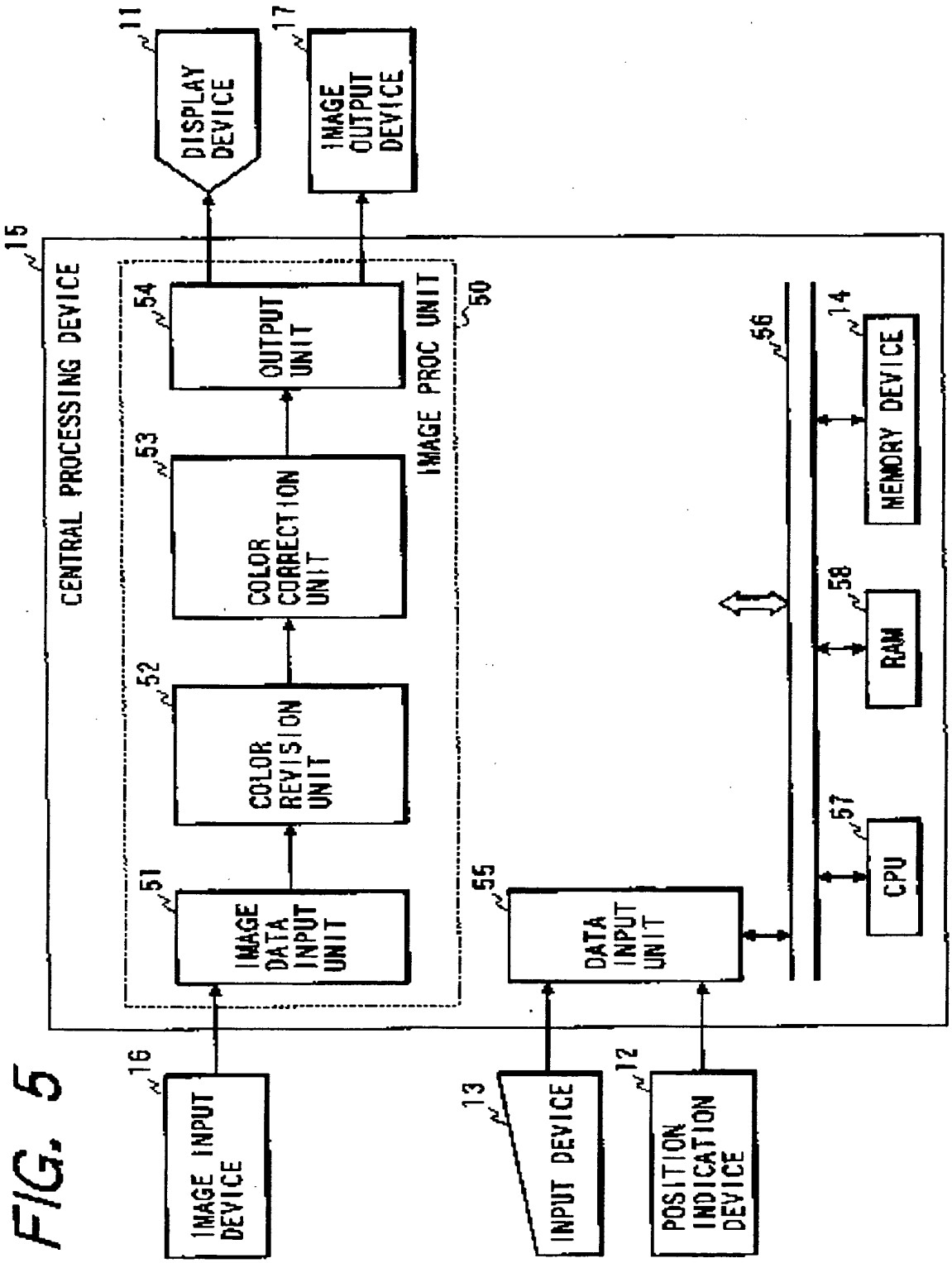

FIG. 6

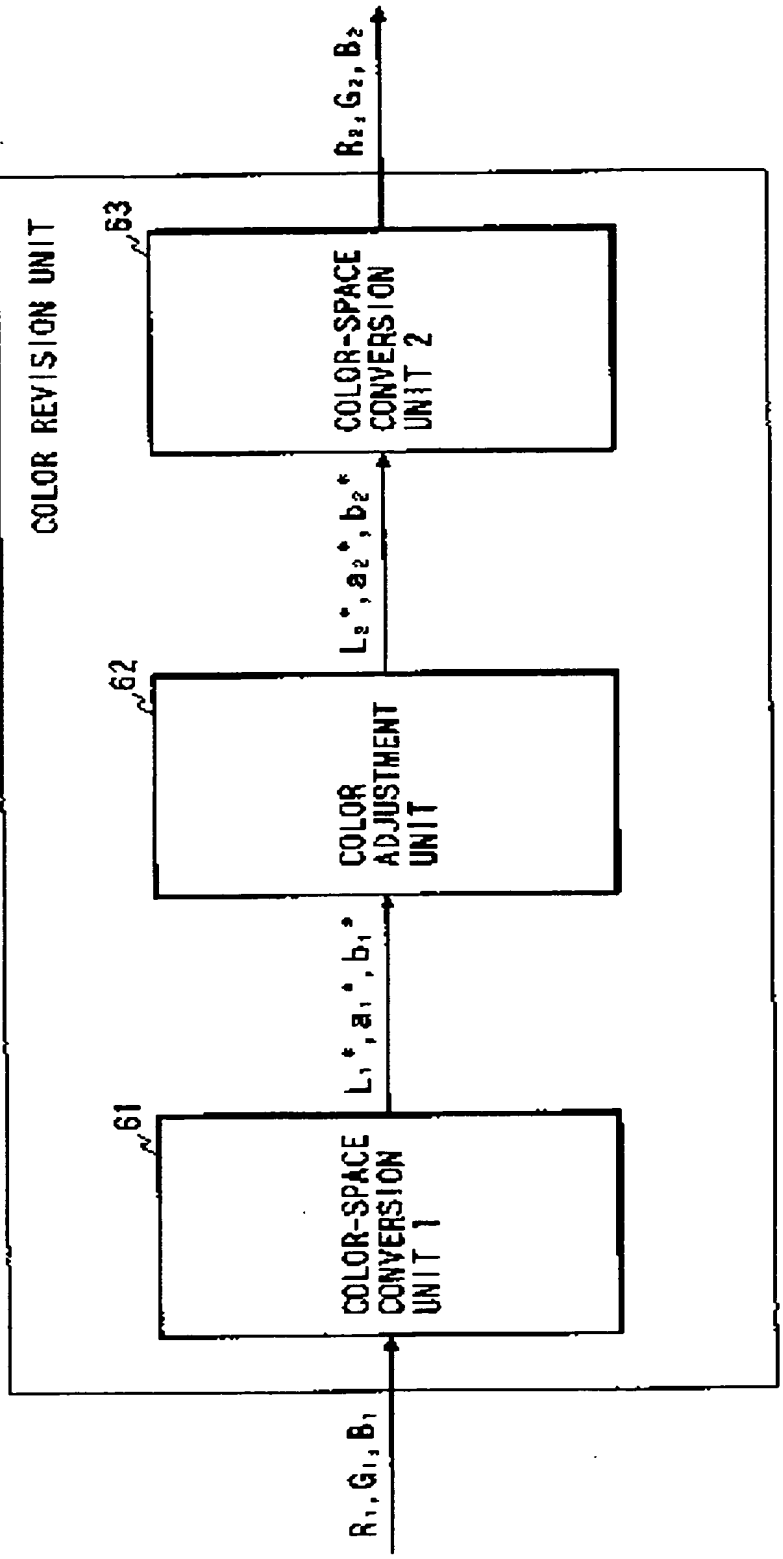

FIG. 7A

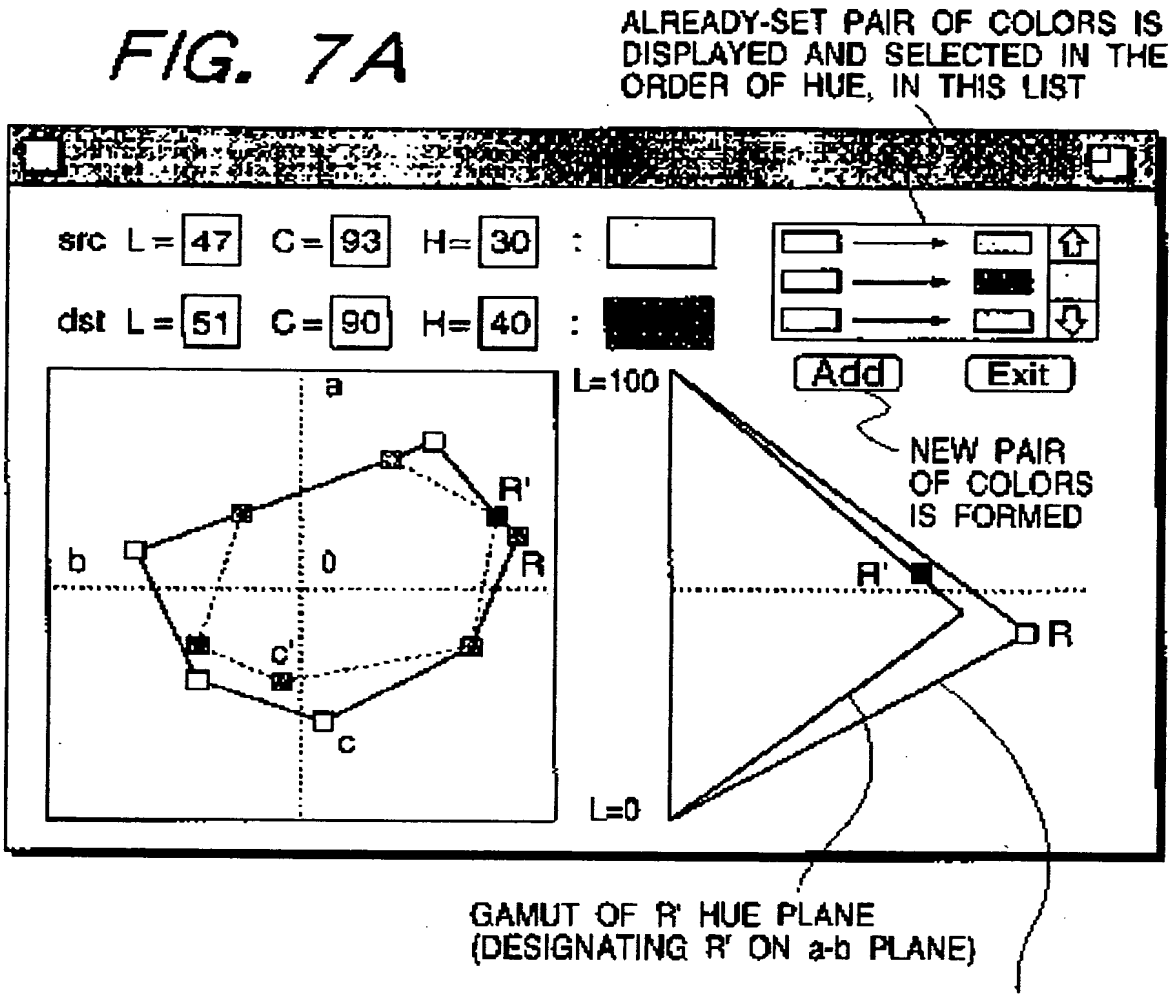

FIG. 7B